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Impact of Spatial Neglect in Stroke Rehabilitation: Evidence from the Setting of an Inpatient Rehabilitation Facility

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Abstract

Objective—To examine the impact of spatial neglect on rehabilitation outcome, risk of falls, and discharge disposition in stroke survivors.

Design—Inception cohort

Setting—Inpatient rehabilitation facility (IRF)

Participants—108 individuals with unilateral brain damage after their first stroke were assessed at the times of IRF admission and discharge. At admission, 74 of them (68.5%) demonstrated symptoms of spatial neglect, as measured with the Kessler Foundation Neglect Assessment Process (KF-NAP™).

Interventions—Usual and standard IRF care.

Main Outcome Measures—Functional Independence Measure (FIM™), Conley Scale, number of falls, length of stay (LOS), and discharge disposition.

Results—The greater severity of spatial neglect (higher KF-NAP scores) at IRF admission, the lower FIM scores at admission as well as at discharge. Higher KF-NAP scores also correlated with greater LOS and slower FIM improvement rate. The presence of spatial neglect (KF-NAP > 0), but not Conley Scale scores, predicted falls such that participants with spatial neglect fell 6.5 times more often than those without symptoms. More severe neglect, by KF-NAP scores at IRF admission, reduced the likelihood of returning home at discharge. A model that took spatial

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Previous presentation of the data: Some data of the same patient cohort were included in another manuscript, for which the research questions differ from the present study. Preliminary results of the present study were partially presented in abstract form at the 2014 annual conference of the American Congress of Rehabilitation Medicine.

neglect and other demographic, socioeconomic, and clinical factors into account predicted home discharge. Rapid FIM improvement during IRF stay and lower annual income level were significant predictors of home discharge.

Conclusions—Spatial neglect following a stroke is a prevalent problem, and may negatively affect rehabilitation outcome, risk of falls, and length of hospital stay.

Keywords

Spatial neglect; functional independence; stroke rehabilitation; fall risk; home discharge

Introduction

"*The patient came to the gym quite upset because of the sign posted on the wall. She only read 'GIVE UP!' from the sign showing 'NEVER GIVE UP!'*" An occupational therapist (OT) at an inpatient rehabilitation facility (IRF) shared this encounter with a patient who had spatial neglect (see more stories in the Appendix). This disorder occurs in approximately 50% of right brain-damaged and 30% of left brain-damaged stroke survivors.[1] Individuals with disordered spatial cognition, which can affect perception and mental representation of spatial information, as well as planning and execution of motor actions, demonstrate failure or slowness to respond, orient, or initiate action towards contra-lesional stimuli,[2] and they may have difficulty in generating contra-lesional mental imagery.[3] Although features of spatial neglect may vary between individuals, the clinical syndrome is defined by deficits that disrupt functions essential in daily life, such as mobility (walking,[4,5] wheelchair use,[6] and driving),[7] reading,[8,9] or appropriate social interactions.[10]

In IRF settings, spatial neglect impedes rehabilitation outcomes, prolongs hospitalization, increases safety risk, and decreases the likelihood of successful community reintegration.[11–16] Despite these adverse consequences, rehabilitation clinicians have not yet addressed spatial neglect systematically.[17–19] This problem may be related to the fact that performance on tasks that are conventional methods of assessing spatial neglect is not always easily translatable to functional outcome. Assessing spatial neglect during activities of daily living (ADLs), rather than using paper-and-pencil or computerized tasks (e.g., star cancellation, figure copying, landmark judgment),[20,21] may enable clinicians to better understand the impact of spatial neglect (see previous studies[1,22,23] for further discussion on the advantage of assessing spatial neglect during ADLs). In addition to conventional assessments, previous studies almost always treated spatial neglect as a dichotomy (i.e., presence vs. absence). However, the severity level of spatial neglect may provide insights to how the disorder predicts an undesirable outcome (e.g., falls) or affects rehabilitation success.

In this study, we assessed spatial neglect during ADLs, using the Kessler Foundation Neglect Assessment Process (KF-NAP™).[22,24] We aimed to confirm the adverse impact of spatial neglect and explore whether the presence or severity of spatial neglect predicts specific outcomes. The KF-NAP is a process to measure spatial neglect using the Catherine Bergego Scale.[25,26] The KF-NAP can be easily adapted to clinical ADL assessment,[1] and it uniquely assesses deficits that cannot be captured by common functional assessments such

as the Functional Independence Measure (FIM™) or the Barthel Index.[1] We investigated whether spatial neglect, measured with the KF-NAP at IRF admission, hinders functional improvement after IRF care, increases risk of falls during IRF stay, prolongs IRF stay, and lowers chances of home discharge.

Methods

Participants and Procedure

The study was approved by the local institutional review board and conducted in an IRF. A consecutive sample of 121 stroke survivors met the inclusion criteria, gave informed consent, and completed the first ADL assessment within 72 hours after admission. We included stroke patients with or without spatial neglect. Whether a patient had spatial neglect was only determined after the patient was enrolled to the study. This was because the goal of the study was to investigate the difference between stroke patients with spatial neglect and those without neglect symptoms. Inclusion criteria were first stroke, unilateral brain damage, and adult (>18 years old). Due to unexpected early discharge, 13 participants did not complete the second assessment, which took place within 72 hours of discharge. The final study sample size was 108. All the included patients had no previous neurological disorder, brain damage, or psychiatric conditions.

Participants' demographic, socioeconomic, and stroke-related clinical information (lesioned hemisphere and time post stroke) was collected upon enrollment into the study. OTs administered the KF-NAP, the FIM, and the Barthel Index in each of two ADL assessment sessions, at admission and discharge. For the purpose of the present study, we used the admission KF-NAP, admission FIM, and discharge FIM scores in the analysis. Data of the Barthel Index and discharge KF-NAP scores had been analyzed in another report[1] and were not included here. After IRF discharge, we extracted further specific outcome measures from medical and administrative records (see Outcome Measures). During IRF stay, participants received the standard 3 hours of daily therapies, which included physical, occupational, and speech therapies. There was no specific protocol or procedure in place for treating spatial neglect in the IRF where the study was conducted.

Assessment for Spatial Neglect

Kessler Foundation Neglect Assessment Process (KF-NAP™)—The KF-NAP consists of 10 categories: limb awareness, personal belongings, dressing, grooming, gaze orientation, auditory attention, navigation, collisions, eating, and cleaning the mouth after a meal.[22,24] Each category is scored from 0 (no neglect) to 3 (severe neglect). The majority (> 94%) of the participants were scored in all KF-NAP categories.[1] When a category was omitted, the final score was calculated with the formula: (sum score ÷ number of scored categories) × 10 = final score. The final score ranges from 0 to 30, and a positive score on the KF-NAP indicates the presence of spatial neglect.

Outcome Measures

At IRF admission, participants were assessed with FIM and the Conley Scale (described below). At IRF discharge, participants were assessed with FIM again, and we collected their number of falls during IRF stay, length of stay (LOS), and discharge disposition.

Functional Independence Measure (FIM™)—The FIM consists of 18 items assessing level of independence in two domains.[27,28] The motor domain includes eating, grooming, bathing, dressing of upper and lower body, toileting, bladder and bowel management, transfers (bed/chair/wheelchair, toilet, tub/shower), and mobility (walk/wheelchair, stairs). The cognitive domain includes comprehension, expression, social interaction, problem solving, and memory. Each item is scored from 1 (maximal assistance) to 7 (complete independence). The measure can be recorded as the FIM Motor score (range = 13–91), the FIM Cognitive score (range = 5–35), and the FIM Total score (range = 18–126).

Conley Scale—Independent from the study, nursing staff administered the Conley Scale[29] at IRF admission. The scale includes three categories of questions asked to patients: history of falls (score = 0–1), altered elimination (0–3), and immobility (0–3). In addition, nurses observe patients' cognitive impairment (0–3). The total score ranges from 0 to 10 with a higher score suggesting a higher fall risk.

Analysis Method

If spatial neglect is an independent factor adversely affecting outcome, the *presence*, rather than the severity, of this symptom may be important. We separated participants into SN− (no neglect; KF-NAP = 0) and SN+ (i.e., spatial neglect present; KF-NAP > 0) groups. To examine effects associated with the *severity* of spatial neglect, we used KF-NAP scores as a continuous variable to further examine a given outcome measure. All the analyses were performed with STATA/SE 12.1.

Results

Participant Characteristics

At admission, 74 of the 108 participants (68.5%) had symptoms of spatial neglect (KF-NAP > 0, median = 7, IQR = 3.75–16). Between SN− and SN+ groups, there was no statistical difference in sex ratio, age, handedness, ethnicity, race distribution, years of formal education, marital status, employment status, or level of annual income (Table 1). Equality-of-medians tests showed that KF-NAP scores did not differ either by sex, handedness, Hispanic cultural background, race (White vs. others), among marital status categories, nor among employment status categories (all p's > .260). In addition, KF-NAP scores did not correlate with age (Spearman's $\rho = -.05$), years of education ($\rho = -.01$), or level of annual income ($\rho = -.09$; all p's > .370).

Overall, the median time between stroke onset and IRF admission was 6 days, which did not differ between SN− and SN+ groups ($p = .241$) or correlate with KF-NAP scores ($\rho = .112$, $p = .250$). At IRF admission, 50% (17/34) of left-brain-damaged (LBD) participants and 77% (57/74) of right-brain-damaged (RBD) participants had symptoms of spatial neglect

(Table 1). RBD participants' KF-NAP scores were higher than LBD's (median = 5 vs. .5, IQR = 1–15 vs. 0–5, n = 74 vs. 34; *U* test: $p = .002$). Thus, spatial neglect was more common and severe after right than left brain stroke.

Clinical Impact of Spatial Neglect

Functional Independence—We previously reported that more severe neglect was correlated with poorer functional independence (KF-NAP and FIM scores) in this study sample.[1] Consistent with our prior finding, the SN− group had a better functional status than the SN+ group at admission and discharge (Table 2; both p's < .001). Improvement of FIM scores was not different between SN+ and SN− groups ($p = .508$), but the SN+ had a slower improvement rate ($p < .001$). Thus, SN+ patients received more days of intensive rehabilitation (longer LOS; see below), with less improvement per day, in order to reach similar degrees of improvement, but did not reach the same level of functional independence as SN− patients.

Furthermore, the more severe the neglect symptoms were, the more slowly FIM Motor scores improved during IRF stay ($\rho = -.23$, $p = .017$). However, this effect was not found in FIM Cognitive ($\rho = .16$, $p = .093$) or FIM Total scores ($\rho = -.16$, $p = .107$). This suggests that a major effect of spatial neglect on motor function and recovery occurs during rehabilitation.

Risk of Fall—Previous studies suggested that spatial neglect is a safety concern[12] and increases fall risk.[15] Here we examined whether spatial neglect correlated with an evaluation for fall risk at IRF admission, or with the actual number of falls during IRF stay. At admission, the SN− group scored lower on the Conley Scale than did the SN+ group (medians = 1 vs. 4; Table 2). In addition, Conley Scale and KF-NAP scores were correlated ($\rho = .318$, $p < .001$).

Since the Conley Scale was used to assess fall risk, the presence and severity of spatial neglect was thus associated with a higher assessed fall risk at IRF admission. If spatial neglect were an independent predictor of falls and not a marker of some other condition or symptoms, we predicted that its presence, but not its severity, would predict actual falls. This was the case. 15 of the 108 participants fell during IRF stay. Among them, 1 SN− and 11 SN+ participants fell one time, and 3 SN+'s fell two times. Thus, the SN+ group fell 6.5 times more often than the SN− group (19.18% vs. 2.94%). Poisson regression analysis revealed no significant predictability of neglect severity (KF-NAP scores) on the number of falls, nor was there predictability of increasing Conley Scale scores ($b = .03$, 95%CI = [−.02, .08], $p = .188$; $b = -.05$, 95%CI = [−.27, .18], $p = .695$; respectively).

Length of Stay (LOS)—Spatial neglect is associated with prolonged hospitalization.[11–13] We confirmed this finding: the SN+ group stayed 10 days longer in the IRFs than the SN− group (Table 2). In addition, more severe spatial neglect at admission predicted a longer IRF stay ($\rho = .54$, $p < .001$).

Discharge Disposition—A few studies reported that presence of spatial neglect reduced the likelihood of returning home at IRF discharge.[12,14] We also found that 48 participants of

the SN+ group (64.9%) and 32 of the SN− group (94.1%) were discharged home. Thus, patients with spatial neglect at IRF admission were 45% less likely than those with no symptom to go home at the end of IRF care. In addition, higher KF-NAP scores at admission, the less likely the participants returned home at discharge (OR = .91, 95%CI = [. 86, .95], $p < .001$).

Post hoc Analyses

Risk of Fall—We have found that the presence of spatial neglect at IRF admission, regardless of neglect severity, predicted falls. Previous studies suggest that right brain damage,[30,31] older age,[15,30] longer time post stroke,[15] lower FIM Motor[31] and Cognitive[32] scores at admission also increase fall risk. We thus performed a Poisson regression analysis to determine whether we could explain more of the variability in our outcome data by adding spatial neglect to known variables in fall prediction. In Model 1, the presence of spatial neglect was the only factor; in Model 2, factors suggested by previous studies were added. Based on the results of Model 2 (Table 3), we performed Model 3 which included factors with p values < .100 in Model 2. Model 3 fitted the data best and explained 12% of variance. This analysis suggests that spatial neglect may indeed increase the predictive value when modeling fall risk, and that younger age may be particularly important in these models, in addition to the presence of spatial neglect. Why younger, rather than older, age is associated with increased fall risk in this dataset is not clear.

Home Discharge—We have found that the severity of spatial neglect predicted a lower likelihood of home discharge. In this post hoc analysis, we wished to explore whether adding spatial neglect to previously-identified factors linked to home discharge increased predictability. The previously-identified factors include better FIM at IRF admission[33–37] or discharge,[34,37] greater FIM improvement rate,[34] younger age,[33,35,38] and the availability of a home-sharing family caregiver.[35–37,39] Additionally, the decision to return home can be affected by demographic background and socioeconomic status[36] or other clinical factors such as risk of fall. We performed an exploratory analysis using logistic models to predict the likelihood of home discharge, excluding 16 participants who did not report their marital status or annual income level. Model 1 contained only one factor, KF-NAP score at admission. Model 2 added factors that had been suggested as predictors in previous studies, and Model 3 further included other available factors that may contribute to the outcome. Lastly, Model 4 only included the factors with p values < .100 in Model 3. Based on the likelihood test results and variance explained (pseudo R^2), Model 3 performed best, predicting 51% of the variance in home discharge (Table 4). Specifically, better FIM improvement rate and disadvantaged socioeconomic status (lower annual income or Hispanic ethnicity) were the most significant predictors.

Discussion

By assessing spatial neglect during ADLs, we confirmed the clinical impact of spatial neglect reported in the literature. Specifically, we found that the *presence* of spatial neglect at IRF admission impeded subsequent functional outcome,[12,14] prolonged IRF stay,[12–14] increased risk of falls,[14,15] and decreased the likelihood of home return upon completion of

intensive inpatient rehabilitation.[12,14] In addition, greater *severity* of spatial neglect at IRF admission was associated with poorer functional outcome at IRF discharge, longer LOS, and decreased rates of home discharge..

Impact on Functional Rehabilitation

Rehabilitation outcome is often measured with the FIM, and shorter inpatient stays may reduce the cost of care and secondary morbidity. Previous and present studies showed that more severe spatial neglect was associated with poorer functional disability[12,14] and longer LOS[12–14] This suggests that increasing available days of intensive rehabilitation may not be enough to help SN+ patients reach a satisfactory level of functional independence before IRF discharge. Since spatial neglect is associated with reduced FIM improvement rate, in particular FIM Motor improvement rate,[40] it may have a direct adverse effect on motor retraining and impede motor learning. Therefore, specific spatial approaches to motor rehabilitation may be greatly needed.[41]

Increased Fall Risk

Participants with spatial neglect fell 6.5 times more often than those with no symptoms. We considered other risk factors reported in previous research (right brain damage,[30,31] older age,[15,30] longer time post stroke,[15] lower FIM Motor[31] and Cognitive scores[32] at admission) and also considered the Conley Scale[29] as a fall predictor in a post hoc analysis. The result showed that the presence of spatial neglect is indeed a significant risk factor for falls. However, although the Conley Scale score and severity of spatial neglect were correlated, the Conley Scale did not predict actual fall incidents; rather, it was the presence of spatial neglect that did. One possible explanation is that higher Conley Scale scores may have been aggressively and specifically targeted for fall prevention by IRF protocols. Adding assessment of spatial neglect to fall risk evaluation may prevent more fall incidents.

Effect on Home Discharge

Returning home is an important goal shared by the majority of inpatient stroke survivors, and is associated with improvement in ADLs and quality of life.[42] In the present study, participants with spatial neglect at IRF admission were 45% less likely to go home after discharge than were participants with no symptoms. As demonstrated in previous research and our post hoc exploratory analysis, the absence or milder symptoms of spatial neglect,[12,14] better FIM scores,[33–37] greater FIM improvement rate,[34] younger age,[33,35,38] stronger family support,[35–37,39] and disadvantaged socioeconomic status (e.g., lower annual income or Hispanic ethnicity) all together predict home discharge. While socioeconomic status plays an important role, FIM improvement rate is the most significant predictor that can be addressed by rehabilitation professionals. Spatial neglect is linked to lesser FIM improvement rate, especially FIM Motor improvement rate, and thus developing strategies to treat both motor dysfunction and spatial neglect may enhance functional motor improvement, which in turn, may increase the likelihood of returning home at IRF discharge.

Study Limitations and Suggestions

Our present results may be only applicable to stroke survivors receiving IRF care. A much larger-scale study — with a larger sample size and including patients with diverse racial, ethnic and demographic characteristics, as well as patients from other post-acute settings, is needed in order to estimate the general clinical impact of spatial neglect on post-acute stroke recovery.

In the present study, OTs performed the assessments. In many rehabilitation settings, OTs share the responsibility of ADL assessment with other disciplines (e.g., physical therapists, speech and language pathologists, and rehabilitation nurses). The rehabilitation outcome measure assessment team can share the responsibility of neglect assessment such as the KF-NAP, which in turn, may encourage inter-disciplinary engagement in the care of patients who struggle to improve effectively due to spatial neglect. Physicians shall always integrate assessment results from all the therapy disciplines, provide solutions in rehabilitation planning, and assist in communications with family and caregivers about symptoms of spatial neglect manifested during daily activities. Having multiple disciplines involved in assessing spatial neglect during ADLs may enhance clinician awareness of spatial neglect and thus encourage systematic treatment, and this care process should be tracked in future clinical studies.

Severity of spatial neglect may change during stroke rehabilitation.[1] At the rehabilitation facility where the current study took place, there was no protocol or procedure for assigning rehabilitative interventions to address spatial neglect specifically. Studies examining whether differences in the way usual and standard care is administered accounts for some of the variation in outcomes have been done in spinal cord injury,[43] and future studies of these differences in rehabilitation in stroke patients with spatial neglect may be appropriate.

Conclusions

Spatial neglect is likely to have a major impact on rehabilitation and increase risks of falls, prolonged hospitalization, and long-term care placement. In order to optimize rehabilitation outcomes in the 30–50% of stroke survivors affected by spatial neglect,[1] specific and systematic spatial rehabilitation is needed. The presence of spatial neglect predicts adverse outcomes, even if symptoms are mild, suggesting that spatial neglect assessment is independently valuable.

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List of Abbreviations

ADL	Activity of daily living
FIM	Functional Independence Measure
IQR	Interquartile range
IRF	Inpatient rehabilitation facility
KF-NAP	Kessler Foundation Neglect Assessment Process
LOS	Length of stay
OT	Occupational therapist

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Appendix

Each of the following stories was reported by one occupational therapist, who did not administer the KF-NAP for the present study.

1. Having difficulty finding his personal belongings in his room caused Mr. A much frustration, and he started showing signs of depression. One day, he told me that he always lost things and that they probably went "to the left" or were "on the left side" because he literally had no idea where the "left" was.

2. At the beginning of his stay, Mr. B would scream a lot. It took us a few days to realize that he thought that he was alone. Because of the way that the bed in his room was positioned and because of his gaze preference away from the neglected side of space, he was unaware that there was a door or he had a roommate. When environmental modifications were made (position of beds) so that the door and his roommate were on his right hand side, his screaming stopped, and he seemed to be more content.

3. When putting on a shirt, Mr. C would "forget" to dress his left arm. When asked to brush his teeth, he would search for his toothpaste for a while if it was on the left side. Sometimes, he would give up searching and proceed without toothpaste instead. When brushing hair, he only did the right side even looking at the mirror. When people spoke to him, he was very attentive and would gesture in response. However, if they were standing on his left side, he would not be aware that they were there or that they were speaking. Once objects or people were brought closer to his body midline, it was as if they magically appeared in his world and he was able to interact with them.

4. Mrs. D came into therapy angry one day telling me that she was never given any utensils or drinks on her food trays, and she always had to ask the nursing aide to get some for her. I asked if she was always looking to the left side of her tray, and

she said yes, so I decided to have lunch with her one day and saw that she of course did have drinks and utensils, but they were all the way on the left side of her tray.

5. Mr. E was able to walk but required close supervision due to the fact that he could not look left or make left turns. Even when I would passively move his head left, his eye gaze would remain to the right. Ironically enough, I found out he was a crossing guard! Unfortunately, he had no awareness of his neglect and wished to return to his job right away. I tried to use his profession as a cueing strategy. I would say “look both ways before you cross” but the strategy was not very effective. He often could not find his way out of a room if the door was on his left. Eventually when he was able to find his way out, it typically took him making three right turns to find the door.

6. I noticed that Mr. F would only receive vegetables during his meal time. One day he had a plate full of broccoli, and the next day a plate full of mixed vegetable. When I glanced at his menu, I found that he would only circle the “broccoli” from the “chicken and broccoli” option, or the “mixed vegetable” from the “beef and mixed vegetables” option. The kitchen must have thought he only wanted the side dish! After pointing this out to him, Mr. F expressed that he was shocked at the choice of food but did not realize there was more to the menu.

7. The first day I met Ms. H I noticed that she had bruises all over her left arm. In our first session together, Ms. H had difficulty propelling her wheelchair because she kept bumping in to objects on her left side. When sitting on the mat, she sat on top of her left hand and was unable to correct herself despite cues. Once Ms. H was able to walk, she would frequently walk into obstacles on the left side and get her hand caught in objects in the environment due to her lack of awareness on the left side.

8. My colleague Michael worked with me on the stroke unit. He was working with Patient J completing a task that required the patient to fill out information on a piece of paper. The paper was set up with the words all along the left side of the page:

   Name:

   Date:

   Place:

   Therapist:

   Patient J filled in the sheet without asking for help. Patient J wrote the following answers:

   Name: Matt

   Date: May 10, 2005

   Place: I am in a hospital.

   Therapist: not Michael

When Michael asked Patient J, “Why did you answer ‘not Michael’ to the ‘Therapist’ question?” The patient said “Because you are not a rapist.”

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Table 1

Characteristics of study participants.

		All N=108	SN− n=34	SN+ n=74	*p* value (comparison between SN− and SN+)
Sex	Male	47	14	33	.452[a]
	Female	61	20	41	
Age	Years; mean (SD)	70.1 (13.0)	71.0 (13.0)	69.6 (13.0)	.603[b]
Handedness	Left	10	3	7	1.000[c]
	Right	97	31	66	
	Ambidextrous	1	0	1	
Ethnicity	Hispanic	11	6	5	.097[a]
	Non-Hispanic	97	28	69	
Race	White	70	19	51	.300[c]
	Black	19	6	13	
	Asian	2	1	1	
	Other (including those identifying “Hispanic” as race)	16	7	9	
	Unknown	1	1	0	
Formal education	Years; median (IQR)	12 (12–16)	13 (12–16)	12 (12–16)	.838[d]
Marital status	Single	13	5	8	.397[c]
	Married	51	15	36	
	Widowed	32	11	21	
	Divorced	9	1	8	
	Not answered	3	2	1	
Employment status	Unemployed	6	1	5	.693[c]
	Employed	37	13	24	
	Retired	65	20	45	
Annual income (prior to stroke)	< $25K	35	12	23	.141[c]
	$25–50K	21	4	17	
	$50–75K	15	3	12	
	$75–100K	7	3	4	

		All N=108	SN− n=34	SN+ n=74	*p* value (comparison between SN− and SN+)
	$100–125K	9	5	4	
	> $125 K	6	4	2	
	Not answered	15	3	12	
Lesioned hemisphere	Left	34	17	17	.007[a]
	Right	74	17	57	
Time post stroke at admission	Days; median (IQR)	6 (4–9)	4.5 (4–8)	7 (4–9)	.241[d]

Note:

[a] Fisher's exact test;

[b] *t* test;

[c] Freeman-Halton test;

[d] *U* test

Abbreviations: SN−, no symptoms of spatial neglect; SN+, spatial neglect present

Table 2

Outcome differences in participants with and without spatial neglect.

		All N=108	SN− n= 34	SN+ n=74	*p* value (comparison between SN− and SN+)
FIM Total median (IQR)	At admission	64.5 (47.5–8.5)	82 (71–92)	56 (43–70)	< .001[d]
	At discharge	94.5 (76.5–111.5)	112 (104–119)	88.5 (68–99)	< .001[d]
	Improvement	28.5 (16.5–34.5)	31 (18–34)	27 (16–35)	.508[d]
	Improvement ratea	1.94 (.96–2.82)	2.81 (2.33–4.86)	1.38 (.75–2.25)	< .001[d]
Conley Scale	median (IQR)	3 (1–5)	1 (1–3)	4 (2–5)	< .001[d]
Number of falls during the stay	0	92	33	59	.034[b]
	1 or more	15	1	14	
Length of stay	Days; median (IQR)	21 (13–26.5)	13 (9–20)	23 (18–27)	< .001[d]
Discharge disposition	Home	80	32	48	.002[c]
	Acute care	1	0	1	
	Sub acute	27	2	25	

Note:

[a] Improvement rate = (score at discharge - score at admission) / days between two assessments

[b] Fisher's exact test;

[c] Freeman-Halton test;

[d] *U* test

Abbreviations: SN−, no symptoms of spatial neglect; SN+, spatial neglect present; FIM, Functional Independence Measure; IQR, interquartile range

Table 3

Poisson models predicting the number of falls.

	Model 1			Model 2			Model 3		
	pseudo R^2 = .07 p = .006			pseudo R^2 = .13 p = .032			pseudo R^2 = .12 p = .002		
	IRR	**95% CI**	***p***	***IRR***	**95% CI**	***p***	***IRR***	**95% CI**	***p***
Presence of spatial neglect at admission (KF-NAP > 0)	7.92	[1.05, 59.50]	.044	7.38	[.82, 66.12]	.074	7.37	[.98, 55.49]	.052
Right-brain stroke				.59	[.19, 1.82]	.360			
Age				.96	[.92, .99]	.022	.96	[.93, 1.00]	.034
Days post stroke at admission				.97	[.89, 1.07]	.573			
FIM Motor at admission				.98	[.94, 1.02]	.423			
FIM Cognitive at admission				1.03	[.92, 1.15]	.603			
Residual	.03	[.004, .21]	< .001	1.69	[.01, 303.15]	.842	.41	[.02, 8.61]	.564
Model comparison (Likelihood-ratio test)				Model 2 vs. 1: $\chi^2(5) = 6.26$, $p = .282$			Model 3 vs. 1: $\chi^2(1) = 4.56$, $p = .033$		
							Model 3 vs. 2: $\chi^2(4) = 1.70$, $p = .791$		

Abbreviations: KF-NAP, Kessler Foundation Neglect Assessment Process; FIM, Functional Independence Measure; IRR, incidence rate ratio

Table 4

Logistic models predicting the likelihood of home discharge.

		Model 1			Model 2			Model 3			Model 4		
		pseudo R^2 = .15 p < .001			pseudo R^2 = .39 p < .001			pseudo R^2 = .51 p < .001			pseudo R^2 = .32 p < .001		
		OR	**95% CI**	***p***	**OR**	**95% CI**	***p***	**OR**	**95% CI**	***p***	**OR**	**95% CI**	***p***
KF-NAP at admission		.89	[.84, .95]	<.001	1.01	[.92, 1.11]	.786	.96	[.85, 1.08]	.469			
FIM at admission					1.04	[.96, 1.13]	.353	1.09	[.97, 1.22]	.131			
FIM at discharge					1.00	[.92, 1.09]	.964	.97	[.86, 1.09]	.621			
FIM improvement rate					4.83	[.95, 24.53]	.058	13.02	[1.23, 137.36]	.033	5.25	[2.35, 11.73]	<.001
Age					1.01	[.95, 1.08]	.723	1.03	[.93, 1.13]	.570			
Marital status (ref = single)	**Married**				6.78	[.92, 49.75]	.060	4.69	[.34, 65.59]	.251			
	Widowed				6.80	[.69, 67.37]	.101	1.63	[.08, 35.20]	.757			
	Divorced				1.19	[.11, 12.90]	.888	.42	[.02, 9.52]	.585			
Female								1.02	[.18, 5.75]	.986			
White race								1.21	[.20, 7.21]	.833			
Hispanic ethnicity								--	--	--			
Years of education								1.27	[.87, 1.84]	.214			
Employment (ref = unemployed)	**Employed**							.63	[.01, 37.71]	.823			
	Retired							.90	[.02, 35.23]	.957			
Annual income level								.40	[.17, .95]	.037	.72	[.46, 1.12]	.141
Conley Scale								1.39	[.91, 2.11]	.129			
Number of falls								4.16	[.50, 34.55]	.187			
Residual		7.61	[3.56, 16.26]	< .001	.002	[<.001, 4.89]	.120	<.001	[<.001, 7.65]	.105	.54	[.16, 1.80]	.313
Model comparison (Likelihood-ratio test)					Model 2 vs. 1: χ^2 (7) = 25.25, p < .001			Model 3 vs. 1: χ^2 (15) = 36.82, p = .001			Model 4 vs. 1: χ^2 (1) = 17.82, p < .001		
								Model 3 vs. 2: χ^2 (8) = 10.97, p = .204			Model 4 vs. 2: χ^2 (6) = 7.44, p = .282		
											Model 4 vs. 3: χ^2 (14) = 19.09, p = .162		

Note: Hispanic ethnicity was omitted from Model 3 because all Hispanic participants returned home at IRF discharge.

Abbreviations: KF-NAP, Kessler Foundation Neglect Assessment Process; FIM, Functional Independence Measure; OR, odds ratio